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CLIMATIC AND GEOGRAPHIC INFLUENCES ON ANCIENT MEDITERRANEAN FORESTS AND THE LUMBER TRADE

ELLEN CHURCHILL SEMPLE

The Mediterranean Basin is a climatic unit. It is a region of winter rains and summer drought, of warm summers and mild winters. The summer drought increases in length and intensity from north to south. The annual precipitation throughout the region as a whole is relatively scant, but it varies greatly from one district to another. It declines from north to south, from highland to lowland, and from the west side of peninsulas and islands to the east side. It ranges from 10 inches at Alexandria to 20 inches at sea level in Crete, 52 inches in Corfu, and over 60 inches on the Alps near Trieste; from 8 inches at Cairo to 36 inches in the mountainous littoral of Algiers; from 16 inches at Athens on the eastern side of Hellas to 40 inches in Cephalonia only 170 miles away on the western side, where the land lies exposed to the rain-bearing winds.* It is not the amount of the rainfall, however, but its seasonal distribution which characterizes the Mediterranean climate.[1]

This climate is due to the location of the Mediterranean Basin between two regions of sharply contrasted precipitation—between the tradewind or desert tract of Africa and the belt of the prevailing westerly winds, which all year round bring rain from the Atlantic to northern and middle Europe. The Mediterranean Basin occupies a transition zone between the two, and partakes in turn of the climatic character of each, according to the season of the year. In summer it approximates the arid conditions of the Sahara; in winter it reproduces the stormy skies and frequent rains of France and Germany; but the aridity is greatly attenuated along the northern rim of the Basin, and the rainy season is similarly attenuated along the southern rim, except

* NOTE.—After reviewing the evidence, the author has reached the conclusion that no appreciable change of climate has occurred in the Mediterranean region in historical times. Therefore recent rainfall statistics are cited.

[1] For general character of the Mediterranean climate and vegetation today, see
A. Philippson, *Das Mittelmeergebiet,* Leipzig, 1907.
Theobald Fischer, *Mittelmeerbilder,* Leipzig, 1908.
Naumann and Partsch, *Physikalische Geographie Griechenlands,* Breslau, 1885.
Wilhelm, Deecke, Italy, Trans. from the German. London.
R. Fitzner, *Niederschlag und Bewölkung in Kleinasien, Peterm. Georg. Mitt. Ergänzungsheft,* vol. xxx, No. 140. Gotha, 1903.
F. Trzebitsky, *Niederschlagsvertheilung auf. der Sudost Europäischen Halbinsel, Peterm. Geog. Mitt.,* vol. 55, Gotha, 1909.
M. Newbegin, The Modern Geography, New York and London, 1911.

where the high Atlas Mountains make a local area of heavy precipitation.

The Mediterranean Basin as a whole is distinguished not only by a common type of climate, but by a type of vegetation whose common physiognomy reflects the prevailing climatic conditions. Thus the ancients described it, and thus we find it today. Trees, shrubs, herbs and grasses in their structure and life course show a close adaptation to their environment. Many of them which were immigrants from northern Europe and central Africa became modified to suit Mediterranean conditions of climate and soil.

Like the Mediterranean climate, Mediterranean vegetation shows a series of graduated transition forms. On the north it merges into the plant life of middle Europe with its dense forests, abundant deciduous trees, juicy grasses and weeds, which are amply watered by the rains all year round, grow during the summer heat, and rest during the winter cold. On the south it gradually passes over into steppe and desert vegetation adapted to arid conditions—a sparse growth of thorny or spiny shrubs armed to resist the prevailing drought and to conserve the meager store of water which they get during the winter showers. Mingled with these shrubs is an equally sparse growth of grasses and herbs which spring up in moister districts after the winter rains, hasten through their few weeks of life, and die down under the parching summer heat. In desert and steppe alike the growth is thin; each plant stands apart from its fellows in an effort to monopolize a maximum space for its thirsty roots.

In type and in location the Mediterranean vegetation stands between these two contrasted groups of plant life. It knows neither the blessing of the all-year rainfall, nor the curse of Africa's aridity, but it has a taste of the latter in the long summer drought, while in the winter rains it gets the abundant moisture of the north, combined with sufficient warmth to keep its life processes going. In winter and spring, therefore, it has its period of growth, and in summer its period of rest. To these natural conditions it has adapted itself, and under them it has spread over Mediterranean lands as far as Mediterranean climatic influences penetrate. It finds its limit not far from the sea itself, because this body of water is the main reservoir of the winter moisture. At a relatively short distance back from the coast the typical Mediterranean vegetation gives place to steppe vegetation, as in Africa, central Spain and Asia Minor. In the mountains, where the winters are colder and the summers moister, it merges into a highland vegetation which closely resembles that of middle Europe, and in higher altitudes it passes over into Alpine types. The genuine Mediterranean vegetation, therefore, belongs to the lowlands and to the vicinity of the coasts. It is most typical in the middle zone of rainless summers found

in southern Spain and Italy, in Greece and Palestine. Farther south it is gradually transformed into the plant life of the steppes; farther north it merges into that of middle Europe.

In this broad transition zone, cereals and other grasses, having superficial roots and hence depending on the surface moisture in the soil, sprout during the warm rains of autumn, grow slowly during the winter, rapidly during spring, and reach maturity in early summer. After this they dry up in the drought and heat. Tuberous, bulbous and annual plants, likewise dependent upon surface moisture, are reawakened to life by the first warmth of spring, grow and blossom and seed while the soil is still damp, thus completing their life processes before the summer drought. To these groups of plants belong the chief crops of cereals and vegetables raised by Mediterranean agriculture. Therefore, from time immemorial winter has been the period of tillage in Mediterranean lands for all native crops, spring or early summer the harvest time, and middle or late summer a season of comparative leisure for farm labor.

Plants and trees that weather the long summer are equipped to resist drought. Many have elaborate root systems, which enable them to gather in moisture from a large area and especially from the deeper layers of soil. Their leaves are commonly narrow, often needle-shaped, so that they present the least possible surface to the sun. Some take the form of spines and thorns, which indicate approach to desert conditions. The leaves have a dark green or gray color, with a polished or resinous surface above and a silvery coating of hairs beneath. All these are nature's devices to diminish evaporation and thus conserve moisture in the plants. Many species of trees are dwarfed and gnarled, with stocky trunks and low branches hugging the ground, where rest the moister strata of air; for the higher the trees, the more they are exposed to the drying action of the winds. Others that grow tall, like the cypress, spring up into a slender spire of dark green, presenting little surface to the sun. Trees and shrubs at sea level are evergreen or nearly so. Even deciduous trees lose their leaves for only a brief space, because they need both the winter rain and summer heat to complete their life functions.

Mediterranean forests reflect the vicissitudes of their life conditions embodied in the long summer drought. The dense continuous forests which stretch across middle and northern Europe under the influence of an ample and well distributed rainfall reach their southern limit just within the northern border of the Mediterranean Basin. Beyond this margin, life conditions fluctuate or fail; the summer water supply is inadequate. Each tree, therefore, appropriates a large area with its spreading roots in order to get sufficient moisture. Consequently Mediterranean forests are usually sparse woodlands or savannahs, open

plantations into which the light penetrates. Genuine forests of the European stamp are found only on the northern rim of the Basin and on high mountains which are able to condense moisture from the summer clouds. They are ample on the Pyrenees, Alps, northern Apennines, the Macedonian highlands, and the mountain coasts of the Black Sea. In southern districts they occur as islands of green foliage on lofty mountains, like the peaks of Sicily, Arcadia, Crete and Cyprus, and especially on westward facing slopes like Mount Amanus and Lebanon. Palestine, even in very early times, knew no forests except the pine woods of Mount Hermon, firs and cedars of Lebanon, and the oak groves of Bashan or Gilead. Scarcity of timber made tall trees conspicuous landmarks and even objects of worship. In the southern lowlands forests degenerate into poor scrub growth, or shrink to detached groups of trees about a spring pool, or contract to a narrow ribbon of foliage along a wadi bed, or are replaced by irrigated plantations of domestic trees as in Egypt, or they succumb to the power of the desert.

The mountains of the Mediterranean Basin show climatic zones of altitude with their appropriate tree growth. On lower slopes the forests consist of mountain pine and evergreen oaks, up to an altitude of 2,000 or 3,000 feet. Above that height grow deciduous trees, like the oak, elm, chestnut and beech; at this elevation they get enough rain to do their life work in summer, when they also get more heat than the winter affords. The chestnut grows at altitudes from 2,000 to 5,000 feet according to the latitude; above it is the beech, and higher still are firs and cedars. Deciduous trees increase in abundance from lower to higher altitudes and from south to north. This is also the ancient distribution described by Theophrastus and Pliny. Theophrastus found the water-loving plane-trees lining the banks of the perennial rivers of Greece;[2] and today the modern traveler, tramping through the Vale of Tempe along the swift-flowing Peneus, enjoys their grateful shade.

The dense forests that covered the mountains along the northern rim of the Mediterranean Basin undoubtedly intensified their barrier nature in ancient times, and helped to discourage invasion by the pastoral nomads of the Eurasian grasslands. The wooded heights of the Caucasus, Balkans and Carpathians probably deflected many a migration away from Asia Minor and Greece, and turned it westward over the open plains of the lower and middle Danube towards Italy and Gaul. But these thick border forests once passed, the early peoples who pushed their way into Mediterranean lands found easy going for themselves and their wide-horned cattle through the open woodlands of the valleys and coastal plains. When they halted to make permanent settlements,

[2] Theophrastus, *De Historia Plantarum*, Bk. iv, ch. v, 6.

they had only thin forests to clear before sowing their crops. This consideration must have been an important factor in territorial expansion in the days when stone and bronze axes were the only weapons of attack upon hardwood trees. Indeed, history gives us hints that the primeval forests of Cyprus[3] and Corsica[4] were a deterrent to the earliest Greek and Roman settlements on these islands.

The relative paucity of trees in the lowlands and coastal strips, just where population settled thickest, resulted in a rapid denudation of the forests about the ancient cities and towns. This in turn gave rise to early importation of various woods from better timbered regions to deforested districts like Attica, and to forestless areas like Philistia and Egypt, whose local species of trees yielded little or no lumber. The result was the very early development of the lumber trade. This supplied the demand for fuel, building materials, cabinet woods and ship timber; the latter included special kinds of lumber for keel, hull, decking, masts and oars.

Owing to the diminution of rainfall from north to south, from west to east, and from highland to lowland, these were exactly the directions in which the chief lumber traffic moved. Exceptions occurred mainly where choice woods from a limited area of production gradually acquired wide use, as in the case of the tall pines of the Caucasus and the unsurpassed cedars of Lebanon. The ebony and teak imported from India over the eastern rim of the Basin met a demand in all the capital cities.

The wide distribution of mountains within and around the Mediterranean Basin made the highlands the predominant source of lumber from the earliest historical times. In the Iliad, Achilles sent mules and wood cutters to Mount Ida to bring oak for the funeral pyre of Patroclus down to the Trojan plain. Later Priam got the fuel for the pyre of Hector from the same source.[5] Mount Pelion furnished the shaft of ash for the spear of Achilles.[6] Sarpedon fell in battle "as falls an oak or silver poplar or a slim pine tree that on the hills the shipwrights fell with whetted axes, to be timber for ship-building." The roar of conflict about the dead Sarpedon was "as the din of woodcutters in the glades of the mountains."[7]

The scant rainfall of the Eastern Basin except on the highlands emphasized the value of the mountain forests. Therefore, the ancients had a sharp eye for this source of their lumber supply. Homer speaks

[3] Strabo, Bk. xiv, ch. vi, 5.
[4] Theophrastus, *Hist. Plant.*, Bk. v, ch. viii, 2.
[5] Iliad, xxiii, 118-121; xxiv, 663.
[6] Iliad, xix, 390-392.
[7] Iliad, xvi, 482-384; 634-636.

of " the topmost crest of wooded Samothrace; "[8] Hesiod knew " where oaks the mountain dells imbranch on high,"[9] and Aristophanes " the wood-crowned summits of the lofty mountains."[10] Theophrastus, discussing the tree life of the Eastern Basin, alludes to the woodlands of the plains, but discourses at length on the important forests of Lebanon and Taurus mountains, Mt. Tmolus of Lydia, the Mysian Olympus, Mt. Odynnos of Lesbos, Phrygian Ida, Mt. Cytorus and the other Pontic ranges of Asia Minor, Haemus and other Thracian mountains, the Macedonian highlands, Thessalian Olympus, the high wooded ridges of Magnesia, certain ranges of northern Hellas, Mt. Parnassus and certain peaks of Euboea, Mt. Cyllene and the Arcadian highlands in general, Mt. Ida of Crete and the Leuca ranges in the western part of that island.[11] He repeatedly emphasized the general superiority of mountain woods for timber purposes, even where a given species of tree grew alike in highland and lowland and reached a taller growth in the more fertile soil of the plain. In the case of mountain trees, he discriminated in favor of forests covering the high level stretches or terraces of plateau and range, as against the stunted timber of the lofty summits.[12] It is a striking fact also that Theophrastus constantly cites the classification, nomenclature and description of trees current among the people of Phrygian Ida, Macedonia and Arcadia.[13] All these were mountaineers, backward in the culture prized by the Attic Greeks, but evidently recognized authorities in everything pertaining to forestry and lumbering.

Pliny, who enumerated the lumber resources of the whole Mediterranean Basin, also noted that the quality of trees depended upon their place of growth. According to him, the best Italian timber came from the Alps and Apennines, the best Gallic woods from the Jura and Vogesus ranges. The Gallic lumber was doubtless floated down the Rhone and Saone to the Mediterranean. Other well-known lumber regions which he enumerated were all mountainous—Corsica, the Pyrennees, Bithynia, Pontus, Macedonia, Arcadia, Crete, the Lebanon district of Syria, and the coast ranges of Roman Africa which yielded the famous Atlas cedars.[14]

As the mountains of the Mediterranean Basin rise almost everywhere directly from the sea, the logs were floated down the drainage

[8] Iliad, xiii, 13.

[9] Hesiod, Work and Days, ii, 203.

[10] Aristophanes, Clouds, 281.

[11] Theophrastus, *Hist. Plant.* Bk. iii, ch. ii, 5, 6; ch. iii, 2-4; ch. v, 1; ch. ix, 5; ch. x, 6; ch. xv, 5; xviii, 3-6, 13. Bk. iv, ch. 1, 2-3; ch. v. 2-7.

[12] Ibid. Bk. iii, ch. iii, 2.

[13] Ibid. Books iii, iv, and ix, *passim.*

[14] Pliny, *Historia Naturalis,* Bk. xvi, chs. 15, 16, 18, 39. Bk. xiii, chs. 15, 16.

streams in flood time to the nearest harbor, whence they were exported. Ancient writers frequently emphasize the accessibility of the timber supply to the coasts. Tyre and Sidon were great lumber ports from early times. When King Hiram made a contract with Solomon to furnish the wood for the new temple of Jerusalem, he sent his expert lumbermen up into the Lebanon ranges and collected the cedar and pine logs (translated "fir" in the Bible) at Tyre. There he made them into rafts and had them towed down the coast to Joppa.[15] Both Tyre and Sidon furnished cedars for the rebuilding of the Jewish temple after the Babylonish captivity, and transported them by sea to Joppa.[16] The various woods of Mount Ida in Phrygia reached Mediterranean trade through the port of Aspaneus, located near the head of the Adramyttene Gulf.[17] Forests which did not command easy transportation to the coast long escaped the woodman's axe, or supplied merely local needs unless general scarcity of timber intensified the demand. After the Macedonian conquest of Cyprus, the Greek kings of the island began to conserve the valuable cedars of their mountains when it proved to be a losing business to pay the freight charges from the interior to the coast.[18]

The Mediterranean lumber trade was more active in the Eastern Basin than in the western, because of the very irregular distribution of forests and the meagre tree growth around the Levantine and Aegean seaboard. The chief importers of lumber were the populous maritime cities surrounding the Aegean, who wanted it for their big merchant marine and various domestic purposes. They used the woods of coniferous trees, like fir, various pines, juniper and cedar primarily for ships,[19] but employed them also extensively in the construction of buildings. Cypress, laurel, box, olive, poplar, maple, wild fig, larch, chestnut, walnut, beech, oak, elm, ash, mulberry, plane and holly were used for carpentry and cabinet work.[20] Keels of ships were occasionally reinforced with oak for greater strength,[21] or with beech when they had to be hauled.[22] The modern is often amazed at the ancient use of woods for manufacturing or building purposes which are now regarded fit only for fuel or wood pulp.

Many woods were widely distributed over the Mediterranean Basin, like the box, olive, fig, various oaks and conifers. Some were found chiefly in southern lands, like the cypress in Cyrene, Crete, Rhodes

15 II Chronicles, ii, 16. I Kings, v, 5-12.

16 Ezra, iii, 7.

17 Strabo, Bk. xiii, ch. i, 51.

18 Theophrastus, *Hist. Plant.* Bk. v, ch. viii, 1.

19 Ibid. Bk. iv, ch. v. Bk. v, ch. 7-8; ch. vii, 1-3, 5; ch. viii, 1-2.

20 Ibid. Bk. v, ch. iii, 1-7; ch. iv, 1-2; ch. vii, 4-8.

21 Ibid. Bk. v, ch. iv, 3; ch. vii, 6.

22 Ibid. Bk. iii, ch. x, 1. Bk. v, ch. vii, 2.

and Lycia,[23] and the palm in the desert belts. Those which supplied the best and most abundant lumber grew on the western slopes of high mountains or in the northern zone of the Mediterranean Basin.

The whole African coast of the Eastern Basin was practically lacking in timber, owing to the semi-desert conditions. The Egyptians cut short planks three feet long from the local acacia trees for constructing their river transport boats,[24] and they utilized the wood of the olive, sycamore (Ficus Sycamorus), *balanos* and doum-palm for cabinet and carpentry work in lieu of anything better.[25] The paucity of their wood supply is indicated by their skiffs made of bundles of papyrus reeds, after the manner of the balsa boats of Lake Titicaca in Peru, and by the use of the papyrus root as fuel. The highland oasis of Cyrenaica had olive, lotus and cypress trees, of which only the last could be used primarily for lumber.[26] The thuya or thyon tree (Callistris quadravalvis), a juniper nearly related to the cypress, grew abundantly in Cyrenaica and the oasis of Ammon in the fourth century B. C. It furnished material for roofs in very ancient times, but as the wood was fragrant and proof against decay, it was valuable for cabinet work.[27] It entered into the trade of the Eastern Mediterranean by way of Crete or Egypt. Homer makes Calypso burn it with cedar and larch to perfume her grotto, and the Book of Revelations, written in the latter part of the first century A. D., alludes to it as a choice wood of commerce.[28]

The absence of forests and paucity of timber trees made these regions of lowland north Africa importers of lumber. The same conditions held in Palestine and the low Philistian coast. Their nearest source of supply lay in the cedar forests of Lebanon, the pine woods of Mount Amanus, which forms a northern extension of the Lebanon range, and the wooded heights of Cyprus. Hence these forested districts were national possessions envied by all the countries around the Levantine Sea. The timber of Mount Amanus and Lebanon occasioned the repeated conquest of these ranges by Egypt in the south and especially by Babylonia in the arid southeast, which had imported thence building material for its temples since 3000 B. C. or earlier.[29] It supplied wood for the Phoenician export trade in cedar and pine logs to Palestine and Egypt,[30] and for countless Phoenician fleets. Tyre secured

23 Ibid. Bk. iii, ch. i, 6; ch. ii, 6. Bk. iv, ch. iii, 1; ch. v, 2.

24 Herodotus, ii, 96.

25 Theophrastus, *Hist. Plant.* Bk. iv, ch. ii, 2, 6-9.

26 Ibid. Bk. iv, ch. viii, 4.

27 Ibid. Bk. v, ch. ii. 7.

28 Odyssey, v. 60. Revelations, xviii, 12.

29 F. Hommel, *Geschichte von Babylonien und Assyrien,* pp. 328-330. Berlin, 1885.

30 J. Breasted, History of Egypt, pp. 95, 114-115, 127. New York, 1909.

ship timber also from the coniferous forests of Mount Hermon, whose great height (8,702 feet or 2,653 meters) insured summer showers, and it imported oak for oars from Bashan.[31]

The mountain forests of Cyprus, together with the copper mines, doubtless furnished the motive for the Phoenician conquest of the island in the eleventh century B. C. Even at this early date the necessity of conserving the Lebanon timber may have become apparent, since the pine groves of Amanus had long before this been seriously invaded. Forests renewed themselves with difficulty under the climatic conditions of the Eastern Mediterranean. For centuries the Cyprian ranges furnished excellent cedar for ship-building; the Greek kings after the Macedonian conquest began to conserve the forests, which were evidently declining in extent and retreating from the shore.[32] Theophrastus states that in his time (313 B. C.) the Syrians and Phoenicians made their triremes of cedar because they had no fir and little pine timber, but that the Cypriots generally preferred Aleppo pine for this purpose because it grew abundantly on the island and was superior to their other woods.[33] Strabo, on the authority of Erastosthenes, states that the forests of the Cyprian plain were once so dense that they formed an obstacle to tillage; that though they were invaded for fuel to smelt the copper and silver from the local mines, and for timber to build whole fleets of ships, nevertheless, consumption did not keep pace with the growth of the forests until, by legal enactment, the act of clearing the land was made to convey title to it.[34] So dense a mantle of trees would indicate a heavier rainfall in Cyprus than the meager 15 inches (37 centimeters) recorded in recent decades. Erastosthenes' account, however, may be based upon traditions of the Bronze Age, when the people of the island had imperfect tools for clearing even their woodlands, and moreover, devoted their energies to mining rather than to agriculture. Yet even in Strabo's time a forest covered the western promontory of Acamas, which was exposed to rain-bearing winds.[35]

The high Taurus Mountains, which wall in the coast of Cilicia Trachea, Pamphylia and Lycia in Asia Minor, get today from 30 to 40 inches of rain (75 to 100 centimeters) from the southwestern storms. The Pisidian Taurus range, back of the Gulf of Adalia, abounded in forests in ancient times. It was drained by the Eurymedon and Melas rivers, which were apparently used as log streams to float lumber down to the coast; because between them lay the seaport

[31] Ezekiel, xxvii, 5, 6.
[32] Theophrastus, *Hist. Plant.* Bk. v, ch. viii, 1.
[33] Ibid. Bk. v, ch. vii, 1.
[34] Strabo, Bk. xiv. ch. vi, 5.
[35] Strabo, Bk. xiv, ch. vi, 2.

of Side, where the Cilician pirates placed their shipyards.[36] The Cilician and Lycian Taurus produced fine cedars,[37] which the pirates used for their swift-sailing boats. The Persians also utilized these timber supplies in the shipyards which they maintained on the Cilician coast. There Artaxerxes in 460 B. C. built three hundred triremes for an attack on Egypt.[38]

After the Roman conquest the chief lumber port of this coast was Hamaxia,[39] near the site of modern Alaja. Just behind this town the Taurus Mountains rise to 10,266 feet (3,130 meters) and therefore get ample precipitation for forests, though the seaboard receives less than 20 inches. All this region was comparatively near Egypt and desirable to her for its timber. Hence that country, whose palm trees yielded poor lumber and whose irrigated fruit trees were too valuable for that purpose, maintained sovereignty over all or part of this forested mountain coast for nearly three hundred years after the break-up of Alexander's empire (323 B. C.). In 300 B. C. the Ptolemies owned Cyprus and the whole southern coast of Asia Minor from Rhodes and Lycia to Issus, but by 218 B. C. their possessions had shrunk to Cilicia Trachea and Cyprus.[40] These were retained till 67 B. C. and 58 B. C., respectively, when they were conquered by Rome; but later Mark Anthony assigned Hamaxia and the neighboring coast of Cilicia Trachea to Cleopatra to furnish wood for the Egyptian fleet.[41] In the thirteenth century Hamaxia had a successor in the port of Alaya, where the Seljuk Turks had shipyards for their navy.[42] So the Cilician forests persisted.

It was especially the northern mountains of the Mediterranean Basin, with their heavier rainfall and denser forests, which yielded the most ample and varied supply of timber, and which, therefore, furnished the chief cargoes for the lumber fleets of ancient times. These cargoes included other ship supplies besides woods, namely, pitch for caulking the seams of vessels, and wax for the encaustic painting of the hulls to make them impervious to water. It is a significant fact that wax and honey invariably figure as forest products in ancient Mediterranean trade, doubtless because numerous flowering trees and shrubs like myrtle, laurel, oleander, tamarisk, hawthorn, lime or linden, wild apple and pear mingled with other forest growth

[36] Strabo, Bk. xii, ch. vii, 3. Bk. xiv, ch. iii, 2.

[37] Theophrastus, *Hist. Plant.* Bk. iii, ch. ii, 6. Pliny, *Hist. Nat.* xvi, 32.

[38] Diodorus Siculus, Bk. xi, chs. 60, 75, 77.

[39] Strabo, Bk. xiv, ch. v, 3.

[40] E. A. Freeman, Historical Geography of Europe, Atlas, maps vi, viii, ix. London, 1882.

[41] Strabo, Bk. xiv, ch. v, 3.

[42] Guy Lé Strange, Lands of the Eastern Caliphates, p. 142. Cambridge, 1905.

and provided honey pastures for the bees. The rainy slopes of the Caucasus Mountains overlooking the Euxine yielded various timbers, especially those suitable for ship-building, besides wax and pitch in great abundance. These forest products were conveyed down the River Phasis to Colchis, whence they were exported.[43] They equipped the navies of Mithridates. Pontic pines, famous for ships, besides other woods used by builders and wheelwrights, were imported into Italy from the Caucasus forests during the last century of the Roman Republic.[44]

Along the northern shore of Asia Minor, from Colchis to Heraclea Pontica and Calpe[45] in Bithynia, the high Pontic ranges facing the Euxine winds were mantled with forests of excellent ship timber, besides oak, elm, chestnut, ash, maple and a superior variety of box. These woods could be easily conveyed away, Strabo tells us. They entered the Mediterranean trade through the ports of Cerasus or Pharnacea, Amisus, Synope and Amastris.[46] The walnut wood exported from Synope was a fine variety used for making table tops. Box trees grew in such perfection and abundance on the Cytorus range[47] in the coastal belt of Paphlagonia that they became proverbial and gave rise to the saying "carrying boxwood to Cytorus," equivalent to the English "carrying coals to Newcastle." The box yielded a very hard close-grained wood, almost proof against decay, used for the manufacture of sacred images, carpenters' tools, flutes and combs.[48] It was evidently imported into Italy for these purposes, for its fame is sung by Vergil, Catullus and Ovid, who always specify the Cytorian or Phrygian variety of box.[49]

In western Bithynia the mountains decrease in height, the rainfall of the Asia Minor coast declines to 28 inches (700 mm.), but the summer showers suffice for the forests. Near the Propontis, the Mysian Olympus rises to the height of 8,300 feet in the face of the Pontic winds, and receives enough precipitation (over 32 inches or 800 mm.)[50] for large, diversified forests.[51] In ancient times its export

[43] Strabo, Bk. xi, ch. ii, 15-18.

[44] Vergil, Georgic II, 440-445, Horace *Carmina,* I, 14, 11.

[45] Xenophon, Anabasis, Bk. vi, ch. iv, 4, 5.

[46] Theophrastus, *Hist. Plant.* Bk. iv, ch. v, 3, 5. Bk. v, ch. vii, 3. Strabo, Bk. xii, ch. iii, 10.

[47] Pliny, *Hist. Nat.,* Bk. xvi, 16. Theophrastus, *Hist. Plant.,* Bk. iii, ch. xv, 5.

[48] Theophrastus, *Hist. Plant.,* Bk. i, ch. v, 4, 5. Bk. v, ch. iii, 1, 7; ch. iv, 1, 2; ch. viii, 8.

[49] Catullus, iv, 3. Vergil, Georgic II, 438. Ovid, Metamorphoses, iv, 311.

[50] R. Fitzner, *Niederschlag und Bewölkung in Kleinasien,* pp. 78-80, rain fall map, p. 91. *Pet. Geog. Mitt, Ergänzungsheft,* vol. xxx, No. 140. Gotha, 1902.

[51] Theophratus, *Hist. Plant.,* Bk. iii, ch. ii, 5. Bk. iv, ch. v, 3. Strabo, Bk. xii, ch. viii, 3, 8.

timber was floated down the Rhyndacus River to the sea,[52] and probably marketed through the Milesian port of Cyzicus. Mysian Olympus and Phrygian Ida furnished to the Aegean world varied and abundant timber, but little that was suitable for ship-building, according to Theophrastus.[53] The fir and pine forests of these ranges were probably approaching exhaustion in his time, 313 B. C. Mt. Ida's proximity to the fertile Trojan plain and the nine successive cities on the site of Ilium would suggest long exploitation of its best lumber. The process went on as late as 424 B. C. after the Athenian conquest of Lesbos, when refugees from the island occupied Antandrus on the mainland near by, and planned to build a fleet from the forests of Mt. Ida, for the purpose of harassing Lesbos and the neighboring coast cities of the Athenian league.[54]

The Aegean front of Asia Minor receives an average rainfall of 25 inches in the lowlands (Smyrna 26 inches or 650 mm.). This is scant allowance for forests, especially in view of the almost rainless summers. The whole region, however, from the Troad to Caria and Rhodes is crossed by numerous short mountain ranges in close proximity to the sea; their peaks, rising from 3,500 to 4,100 feet and receiving about 30 inches or 750 mm. of rain,[55] doubtless offered in ancient times sufficient timber for the needs of the early Phoenician and Greek colonies along this coast. Forested promontories and island peaks, like Mimas (3,803 feet or 1,190 meters), Mycale (4,150 feet or 1,265 meters), Mt. Atabyrius in Rhodes (4,067 feet or 1,240 meters) and Mt. Pelinnaeus in Chios (4,147 feet or 1,264 meters), were probably one attraction to settlers who sought the deep-running inlets for their new homes. The ranges were neither long nor very high, however, and had evidently lost much of their forest covering by the Christian Era. Theophrastus mentions only the woods of the Phrygian Mountains, which lie farthest north, and those of the Tmolus Mountains in Lydia, which, however, yielded no ship timber.[56] In Strabo's time, the bold sea-washed ridges of Mycale and Mimas were still well forested and harbored abundant game, while the hill country of Ortygia near Ephesus had woods of various trees, especially cypress groves.[57] The latter doubtless furnished the famous doors of the temple of Diana, but the cedar planks for its roof[58] were undoubtedly imported from Crete, Lycia, Phoenicia or Cyprus. The early exhaus-

52 Theophrastus *Hist. Plant.*, Bk. v, ch. iii, 1.

53 Ibid. Bk. iv, ch. ii, 5.

54 Thucydides, iv, 52.

55 R. Fitzner, *opus cit.* rainfall map, p. 91.

56 Theophrastus, *Hist. Plant.* Bk. iv, ch. v, 3, 4.

57 Strabo, Bk. xiv, ch. i, 12, 20, 33.

58 Vitruvius, *De Architectura*, Bk. ii, ch. ix, 13. Pliny, *Hist. Nat.*, xvi, 79.

tion of the local supply of ship timber forced the big trading cities of this coast to search for it abroad. Miletus, which required much timber for her merchant marine, may have established her Pontic colonies of Synope, Amisus, Cerasus and Trapezus partly for the purpose of controlling her own ship supplies. Even Cyzicus could furnish timber from Mysian Olympus.

The busy maritime cities of eastern Greece, located in the rain shadow of the Grecian highlands, were even more dependent upon imported lumber, because their local hills and mountains, according to Theophrastus, yielded only inferior woods. Megara, when she founded the colony of Heraclea Pontica on the Euxine, selected a spot which today, as the modern Eregli, has the reputation of being unusually rainy and well timbered.[59] Heraclea was therefore designed to exploit for Megara's benefit the forests of the Pontiac ranges as well as the abundant yield of the coast fisheries there. Athens, whose local mountains were practically denuded of their forests in the time of Plato,[60] brought lumber from great distances, both for naval purposes and for building. Even fencing and beams for the Laurion mines came from over sea.[61] The construction of lumber rafts equipped with sails was familiar to the Greeks. Athens occasionally secured ship timber from Phoenicia or Cyprus, and undoubtedly organized her vast Pontic trade in the days of her maritime empire with a view to the importation of Pontic lumber. She drew also upon the forest supplies of the west. The speech of Alcibiades revealing to the Spartans the Athenians' motives for the Sicilian Expedition specifies the control "of the ship timber which Italy supplies in such abundance,"[62] and points to an established lumber trade with the Greek colonies of Magna Graecia and Sicily. A century later Theophrastus shows so detailed a knowledge of Italian woods[63] as to indicate their presence in the Athenian market, whither they had come in exchange for manufactured Greek wares. "The tall pines and crested oaks" of Sicily had been famous from Homeric days.[64]

The nearest and most abundant supply of good ship timber for the cities of eastern Greece was found in Thrace and Macedonia,[65] where a northern location, moderate summer showers and extensive mountain ranges insured considerable forests. The best watered and therefore

[59] R. Fitzner, *opus cit.*, p. 80. E. Banse, *Die Turkei*, p. 83. Berlin, 1919.

[60] Plato, Critias, chap. v, p. 418. Trans. by Henry Davis. London, 1870.

[61] A. Broeckh, The Public Economy of Athens, p. 138. Trans. from German. Boston, 1857.

[62] Thucydides, vi, 90.

[63] Theophrastus, *Hist. Plant.*, Bk. iv, ch. v, 5.

[64] Odyssey, ix, 112-120, 186.

[65] Xenophon, Hellenes, Bk. vi, ch. i, 11.

the best wooded section lay between the Strymon and Hebrus rivers. The coastal plain here receives about 25 inches (625 mm.) of rain annually, but the great Rhodope highland forming its hinterland has 30 to 40 inches or more (750 to 1,000 mm.).[66] There at the mouth of the Strymon River lay the important Athenian colony of Amphipolis, founded only after repeated efforts, owing to the hostility of the local tribes.[67] Significantly enough, its site had previously been selected by an abortive colony from Miletus.[68] Contiguous to this region, less rainy, but offering protected sites for coast settlements, was the Chalcidice Peninsula, colonized by Chalcis, Eretria, Andros and Corinth. All these cities doubtless counted chiefly on the forest products among the raw materials which were the natural exports of a new and backward region.

Theophrastus recognized the general superiority of the northern timber.[69] The woods imported into Hellas for building and carpentry work he graded according to quality, as follows: Macedonian, Pontic, Mysian-Olympian, Aenianian from the high slope of the Oeta (7,078 feet or 2,158 meters) and Tymphrestus ranges (7,606 feet or 2,319 meters) in northern Hellas, down to the poor knotty timber from Mount Parnassus and the Euboean ranges. Wood of variable quality was also brought from highland Arcadia,[70] where the peaks have considerable forests even today. All the maritime cities made a steady demand for the strong, light, durable Macedonian fir, which was used for oars, masts and sailyards. Athens imported this timber through her colony of Amphipolis, which commanded the forests of the Strymon River basin. Therefore she was dealt a heavy blow when this town and its port of Eion were captured by the Spartans in 424 B. C. during the Peloponnesian War, since her navy needed constant replenishing.[71] Later the expansion of Macedon over all this coast as far as the Hellespont excluded Athens from her nearest and surest lumber supply, and jeopardized her sea connection with the Caucasus and Pontic forests, until her incorporation into Phillip's empire again opened these sources of supply. Athens revolted from Cassander in 305 B. C. and forfeited her right to use the Macedonian forests. Then she turned to Demetrius of Syria and was promised timber for a hundred war ships.[72] The wood doubtless came from the Lebanon range.

66 F. Trzebitsky, *Niederschlagsvertheilung auf der Sudost-Europaischen Halbinsel, Pet. Geog. Mitt.*, vol. lv, pp. 186-7. Gotha, 1909.

67 Thucydides, i, 100; iv, 102.

68 Herodotus, v, 124-126.

69 Theophrastus, *Hist. Plant.*, Bk. i, ch. ix, 2.

70 Ibid. Bk. v, ch. ii, 1.

71 Thucydides, iv, 108.

72 Plutarch, Lives, Demetrius, x.

The Macedonian forests long remained the chief source of lumber for the Aegean states.[73] In 158 B. C. we find Rome prohibiting the export of ship timber from Macedon, evidently as a measure to cripple the commerce of Rhodes,[74] which was then the great middleman of the Aegean. These forests were not exhausted in Strabo's time, because the town of Datum near the mouth of the Strymon River on the Strymonic Gulf had dockyards for ship building,[75] evidence of accessible timber. But it must be remembered that this river drains an extensive highland region, which, owing to its elevation and northern location, gets a moderate rainfall in summer.

Deciduous trees, especially timber growth like the oak, ash, beech and chestnut, were widely distributed in northern and western Greece; but on the dry eastern side of the peninsula, where the rainfall rarely exceeds 25 inches, and in many localities falls far below, these trees were generally restricted to the mountains. The chestnut tree, still found in groves on Mount Olympus and the Pindus range, grows in Hellas at altitudes of 2,000 to 4,000 feet (600-1,300 mm.), but declines in size and abundance farther south. Theophrastus calls the sweet chestnut (*Castanea vesca*) the "Euboean nut." It grew on the Mysian Olympus and the Tmolus range of Lydia, whence it was called "the nut of Sardis," but was more abundant on the mountains of Euboea and the Magnesian Peninsula of Thessaly.[76] Near the foot of Mount Pelion, which still has its chestnut trees,[77] was located the Magnesian seaport of Castanea, mentioned by Herodotus and Strabo.[78] Thence probably the nutritious nuts were shipped to the large Greek cities, and took their name from the place of export, like the modern Brazilian nut. Today the best chestnuts are brought to Athens from the mountains of western Crete, where an altitude of 7,500 feet or more compensates for the southern latitude. This island, owing to its mountainous relief and its exposure to rain-bearing winds, was well wooded in ancient times[79] and supported a variety of trees, especially cypress[80] and cedar.[81] These helped to maintain the navies of King Minos and the fleets of the Cretan pirates, and met a steady demand for architectural purposes both in Athens and Rome. The finest and most abundant tree was the cypress, which grew very tall on the Cretan

[73] Theophrastus, *Hist. Plant.*, Bk. iv, ch. v.
[74] Mommsen, History of Rome, vol. ii, pp. 358, 364. New York, 1872.
[75] Strabo, Fragments, 33, 36.
[76] Theophrastus, *Hist. Plant.*, Bk. iv, ch. v, 4.
[77] Leake, Travels in Northern Greece, vol. iv, p. 393. London, 1835.
[78] Herodotus, vii, 183, 188. Strabo, Bk. ix, ch. v, 22.
[79] Strabo, Bk. x, ch. iv, 4.
[80] Theophrastus, *Hist. Plant.*, Bk. iii, ch. i, 6; ch. ii, 6; ch. iii, 3, 4.
[81] Vitruvius, Bk. ii, ch. ix, 13.

mountains. It yielded a superior building and cabinet wood almost proof against decay.

Oak and beech groves were widely distributed over the mountains of Greece, and furnished mast for large herds of wild and domestic pigs. Oaks especially grew on Mt. Olympus and Pelion. They covered the low Calledromus range of eastern Locris[82] and Mt. Ptous in Boeotia.[83] They flourished on the Arcadian highlands and covered the heights of the Parnon range on the boundary between Argolis and Laconia.[84] The Laconian side of the high Taygetus Mountains, especially about the peak of Taletum, had forests in the second century A. D.[85] which were presumably fir and vallona oak groves such as Leake found there nearly a century ago.[86] The Taygetus Mountains now turn a bare rocky front to the Eurotas valley, except where the gulches retain soil and moisture. But the slopes, now washed bare of their humus or converted into terraced vineyards, were once mantled in oak trees which Theophrastus found characteristic of Laconia.[87] The modern traveler who motors from Sparta to Tegea in Arcadia, across the mountains forming the northern boundary of Laconia, finds these highlands (pass at 3,065 feet or 940 meters) covered with a poor oak brush, preyed upon by goats, which represents the degenerate successor of the pristine oak forests.

Western Peloponnesus presents even today a pleasant contrast to the bald eastern escarpment of Arcadia, which is located in the rain shadow of the central highland. The half of Greece lying west of the mountain backbone of the peninsula, formed by the Taygetus, Arcadian, Corax, Tymphrestus and Pindus ranges, has 30 inches (750 mm.) or more of rain a year. From the Gulf of Ambracia (Gulf of Arta) northward, the broad belt of coastal highlands is yet better supplied, and gets over 40 inches (1,000 mm.) annually; moreover, it receives slight summer showers to revive its vegetation, and these increase in frequency from Illyria northward.[88]

This western front of classical Greece had sufficient rainfall to maintain considerable forests, remnants of which still survive the depredation of the goats, where located far from human habitations. In ancient times even the plain of Elis had its oak groves and woods of wild pine.[89] Forests large enough to harbor abundant deer, wild boar

82 Herodotus, vii, 218.

83 Pausanas, Bk. ix, ch. xxiii, 4.

84 Ibid. Bk. viii, ch. xi, 1; ch. xii, 1; ch. liv, 5. Bk. iii, ch. xi, 6.

85 Ibid. Bk. iii, ch. xx, 4.

86 Leake, Travels in the Morea, vol. i, pp. 128, 132, 251. London, 1830.

87 Theophrastus, *Hist. Plant.*, Bk. iii, ch. xvi, 3.

88 Philippson, *Das Mittelmeergebiet*, p. 121, maps iii, iv. Leipzig, 1907.

89 Pausanias, Bk. v, ch. vi, 4.

and antelope covered the low hill country near Olympia and the higher Phoeloe Plateau,[90] which defined the boundary between Elis and Arcadia. There Xenophon and his sons used to range the forests for game before the crowds assembled for the Olympic Games.[91] The towering peaks of western Arcadia, which overlook the Elian plains, were well forested in ancient times. Mount Lycaeus was mantled in maples and oaks, and therefore was sacred to Zeus.[92] On Mount Erymanthus was staged the famous boar hunt of Hercules, which bears witness to mast groves of beech and oak. These trees grow on its slopes today, interspersed with planes; and in spring their tender green makes a background for the white blossoms of the wild pear tree.[93]

The northern flank of mighty Erymanthus belongs to Achaia, which today has the amplest forests of oaks and conifers to be found in all the Peloponnesus, and in ancient times must have been even more abundantly supplied.[94] The ancient province occupied the northern and northwestern escarpment of the Arcadian plateau, and sloped down from a succession of lofty peaks like Erymanthus (modern Olonos, altitude 7,300 feet or 2,225 meters), Panachaicus (Voidhia, 6,320 feet or 1,927 meters), Aroanio (Khelmos, 7,724 feet or 2,355 meters) and Cyllene (Ziria, 7,790 feet or 2,375 meters). These mountains today have oak woods on their middle zone and fir forests on their upper reaches,[95] owing to the rain-bearing winds that sweep through the Gulf of Corinth. In ancient times they undoubtedly furnished convenient supplies of timber to the shipyards of Corinth and Sicyon, because they offered a choice of cedar,[96] fir and oak.[97]

Across the Corinthian Gulf the mountainous coasts of western Hellas still have scattered woodlands which bear testimony to ancient forests. Parnassus, towering to the height of 8,070 feet (2,460 meters) behind the Crissaean Bay, has beautiful pine woods at 3,000 feet elevation; and its western slope is covered with a thriving, young growth of beech, oak, and conifers, through which the modern automobile road runs from Delphi north to Gravia. Groves of cypress and pine near Oeanthia in Locris in ancient times faced the Gulf of Corinth from this northern shore.[98] Naupactus, the important seaport and naval station of this coast, lay only ten miles from the Evenus River (modern Phidari) of Aetolia, whose valley was clothed in oak forests when Leake

[90] Strabo, Bk. viii, ch. iii, 32.
[91] Xenophon, Anabasis, Bk. v, ch. iii, 9-12.
[92] Pausanias, Bk. ix, ch. xxiii, 4.
[93] Leake, Travels in the Morea, vol. ii, p. 232. London, 1830.
[94] Pausanias, Bk. vii, ch. xxvi, 10.
[95] Leake, Travels in the Morea, vol. ii, pp. 112-117. London, 1830.
[96] Theophrastus, *Hist. Plant.*, Bk. iii, ch. ii. 5. Bk. iv, ch. i, 2.
[97] Pausanias, Bk. vii, ch. xxvi, 10.
[98] Pausanias, Bk. x, ch. xxxviii, 9.

visited it a century ago.[99] This stream flows out to sea between mountains over three thousand feet high, and reaches the coast between the sites of Homeric Calydon and the ancient Corinthian colony of Chalcis.[100] It doubtless brought down wood to build the Calydonian fleet which sailed for the Trojan War, and centuries later, ship timber to be exported to the treeless city of Corinth. All the mountains fronting this north coast of the Gulf of Patras were well wooded on their upper slopes a century ago, though cleared for cultivation below. Oak trees growing there were big enough to furnish the dug-out boats used in the navigation of the shallow Lagoon of Mesolongion between the mouth of the Evenus and the Achelous (Aspropotamo).[101] The Achelous River opened up the well-wooded mountains of Acarnania, which faced the rain-bearing winds from the west.

To the forests of the Ionian Islands Homer himself bears witness. He was familiar with "wooded Zacynthus," the tree-grown slopes of showery Ithaca, and the wind-swept woods of Neritus.[102] Abundant timber was one factor in the nautical development of all these western islands and coastlands from Zacynthus north to Epidamnus (Dyrrachinin or Durazzo) on the Illyrian seaboard. Moreover, the numerous colonies planted by Corinth on these coasts in Corcyra (Corfu) Ambracia, Leucas and Epidamnus[103] suggest that the mother city, poorly provided with wood, wished to assure her supply of ship timber for her big navy and merchant marine from these western sources. From these she could not easily be cut off by great commercial rivals like Aegina, Euboean Chilcis, and Athens, which lay on the Aegean side of the Isthmus, while Corinth could import the western lumber through her port of Lechaeum on the Gulf of Corinth.

The mountains surrounding the Gulf of Ambracia (Arta) a hundred years ago still abounded in large oaks and conifers well suited to naval construction. In 1788 and for seven years thereafter ship timber from these slopes was regularly exported from Prevesa to the French navy-yard at Toulon.[104] When Augustus Caesar planted the important naval base of Nicopolis at the entrance of the Gulf of Ambracia,[105] he chose the location with remarkable insight. This big inlet marked the southern border of Epirus and of the area of heavy rainfall with occasional summer showers, which characterized the Adriatic front of

99 Leake, Travels in Northern Greece, vol. i, p. 108. London, 1835.

100 Thucydides, i, 108.

101 Leake, Travels in Northern Greece, vol. i, pp. 113-114. London, 1835.

102 Iliad, ii, 361, 632. Odyssey, i, 246; xiii, 243-6; xiv, 1-2.

103 Thucydides, i, 24, 30, 80.

104 Leake, Travels in Northern Greece, vol. i, 163-6, 172, 181-2; vol. iv, 47-50. London, 1835.

105 Strabo, Bk. vii, ch. vii, 5-6.

the Balkan Peninsula.[106] The forests of western Hellas culminated in the mountains of Epirus. There the famous oak grove of Dodona formed the earliest sanctuary of Zeus, the Thunderer. Beyond Epirus lay the rainy coasts of Illyria and Dalmatia, whose forests supplied the pirate fleets infesting these shores from ancient times.

According to the evidence, the crying need of eastern Mediterranean lands was for ship timber. A multitude of fishing smacks, naval vessels, merchant ships, and coastwise transportation boats kept up the demand for fir, pine, cedar and minor woods which entered into their construction. The coniferous forests were therefore constantly levied upon; and they were further depleted by the steady demand for pitch, tar and resin. Traffic in these usually accompanied the lumber trade, and emanated from the same sources of supply. Pitch and tar were doubtless procured from pine and fir trees in all parts of Greece, but the chief output came from the Caucasus, Phrygian Ida, and Macedonia, especially from the extensive coniferous forests on the northern slopes of Mt. Olympus and Mt. Pierus in southern Macedonia.[107] In Syria pitch was distilled from terebinth and Phoenician cedar,[108] and was exported thence to Egypt, where it was used, among other things, for treating the surface of the bulrush boats.[109]

The demand for all products of resinous woods was relatively greater in antiquity than now. They were employed for the preservation of ship wood and all ship equipments, for coating the interior of earthenware wine jars, and for the preparation of volatile oils, salves and ointments, which were almost universally used in ancient times. Resin and tar were the chief basis of cough medicines prepared by Greek physicians, and were ingredients of salves for external use. Oil of cedar, distilled from the Syrian cedar, was regularly used for these purposes, because its antiseptic or cleansing qualities were recognized.[110] It was exported from Phoenicia to Egypt where it was needed for embalming the dead.[111] The Romans used it for soaking wood as a protection against decay and insect attack.[112] This was the ancient forerunner of the modern creosoting process.

The Western Mediterranean Basin, owing to more ample and protracted rains, was fairly well supplied with timber in nearly all its

106 F. Trzebitsky, *opus cit.*, pp. 186-7.

107 Vergil, Georgic III, 450. Pliny, *Hist. Nat.* xiv, 20. Theophrastus, *Hist. Plant.*, Bk. ix, ch. ii, 3-4; ch. iii, 1-4.

108 Theophrastus, *Hist. Plant.*, Bk. ix, ch. ii, 2, 3. Bk. iv, ch. vi, 1. Bk. iii, ch. xv, 4.

109 Exodus, ii, 3.

110 Naumann and Partsch, *Physikalische Geographic Griechenlands,* pp. 376-7. Breslau, 1885.

111 Herodotus, ii, 87. Pliny, *Hist. Nat.*, xvi, 11.

112 Vitruvius, *De Architectura,* ii, 9.

parts. This was true even of its African coast, because the high Atlas ranges tracing this littoral extract rain from the prevailing north winds. Hence they supported forests of big trees in ancient times.[113] The woods on the mountainous Rif coast of western Mauretania in places came down close to the sea, and clothed the promontory of Mt. Abila at the Strait of Gibraltar with a mantle of great trees.[114] These doubtless furnished timber for the ships of the Rif pirates who for two thousand years sallied out from that rugged littoral. The highest peak of the western Rif range, the modern Beni-Hassan, rises to an altitude of 7,216 feet or 2,200 meters, and lies only about twelve miles from the sea so that its timber was readily accessible. Farther east, in Algeria (ancient Mauretania Caesariensis and Numidia) the rainfall varies along the coast ranges from 24 to 32 inches (600 to 800 mm.), but exceeds this maximum in the great highlands of the Grand and Little Kabyle (ancient Byrinus Mons) where peaks towering to 7,000 feet or more get 60 inches (1,500 mm.).[115] This was essentially the region of the famous *Atlantis silva,*[116] or forests of a tree known to the Romans as the *citrus,* but quite distinct from the *citrus Medica* or citron. The tree was nearly related to the cypress, and yielded a beautifully variegated wood, which was imported into Italy for the manufacture of fine furniture and coffered ceilings.[117] Pliny identifies it with the thyou or thuya tree of the Greeks, which is still a product of Moroccan and Algerian forests, and is used by the Turks in their mosques as the choicest material for ceilings and floors. Among the ancient Romans the wood was highly prized and very costly. Tables of it sometimes measured four and a half feet in diameter, and sold in Cicero's time, before the days of degenerate luxury, for a million sesterces or twenty thousand dollars.[118] Martial reflects the popular estimate of the wood when he writes:

> Accipe felices, Atlantica munera, silvas:
> Aurea qui dederit dona, minora dabit.[119]

Some commentators identify this *citrus* with the *cedrus* or cedar tree of the Atlas Mountains, which Pliny rated as high as the cedars of Lebanon.[120] Vitruvius, who was an authority on architectural materials, made the same estimate of this wood. It was abundant in ancient as in modern times, and was exported to Rome. Beams of Numidian

113 Pliny, *Hist. Nat.,* v, 1.
114 Strabo, Bk. xvii, ch. iii, 4, 6.
115 Vidal-la-Blache, Atlas, map 2, p. 79. Paris, 1906.
116 Lucullus, x, 144.
117 Horace, *Carmina,* Bk. iv, 1, 20.
118 Strabo, Bk. xvii, ch. iii, 4. Pliny, *Hist. Nat.,* xiii, 15. Lucanus, ix, 416.
119 Martialis, xiv, Ep. 89.
120 Pliny, *Hist. Nat.,* xvi, 39.

cedar used in the construction of the Temple of Apollo at Utica[121] when the city was founded undoubtedly came from these forests. We must look to the same source for the ship timber which for centuries built the Carthagenian fleets.[122] Cork and tanners' bark have through the ages contributed to the trade of Saldae (Bougie) and Hippo Regius (Boné).

Owing to the more general distribution of forests in the Western Mediterranean Basin, the lumber trade seems never to have reached the development which it attained in the Levantine and Aegean Seas. In the days of Rome's splendor it brought building materials and choice cabinet woods from various regions to the rich and growing capital, and furnished ship supplies for the maintenance of the navy. Italy itself included the districts of heaviest rainfall and therefore of the best forests of ship timber, but certain other ship supplies, such as tar, pitch and wax, were economically produced elsewhere. Their bulk was small in relation to their value; so transportation charges were an almost negligible element in their market price.

Pitch was a regular article of commerce, procured from regions of ample coniferous forests; it was usually coupled with ship timber, resin, honey and wax. The Sila Mountains of the southern Apennines, today as in ancient times an important lumber region,[123] produced the famous Bruttium pitch of the Roman world.[124] This was evidently exported through the harbor of Narycium, the old Greek Epizephyrii, for Vergil couples the pitch-yielding forests with that city.[125] Gades (Cadiz) in southern Spain used the local ship timber for her own merchant marine, but supplied to Mediterranean commerce pitch, honey, wax and quantities of kermes berries or cochineal,[126] which point to oak forests. Cadiz and its vicinity get about 30 inches (750 mm.) of rain a year; but to the east rises the great Sierra de Volox with a peak 6,530 feet (1,960 m.), and from this range ample forest products were doubtless obtained. The still higher Sierra Nevada, culminating in the peak of Mulhaden (11,418 feet or 3,481 meters), and the northeastern extension of these highlands in the Sierra de Segura, rising in the Sierra Sagra to 7,872 feet (2,400 meters), were called by Strabo the mountain chain of the Bastetani, and described as thickly wooded with gigantic trees.[127] This was probably an exag-

121 Ibid., xvi, 40.

122 E. Speck, *Handelsgeschichte des Altertums*, vol. iii, Part I, ¶ 522. Leipzig, 1905.

123 Pliny, *Hist. Nat.*, iii, 5. W. Deecke, Italy, pp. 428-430. London, 1904.

124 Strabo, Bk. vi, ch. i, 9. Pliny, *Hist. Nat.*, xv, 7.

125 Vergil, Georgic II, 438.

126 Strabo, Bk. iii, ch. ii. 6.

127 Strabo, Bk. iii, ch. iv, 2.

geration in view of the moderate rainfall of 20 to 30 inches, but the forests were ample enough to supply the Phoenician coast colonies of Malaca (Malaga), Maenaca, and Abdera. New Carthage probably drew the ship supplies for its busy port from Sierra Sagra by way of the Tader River (Segura), which rises on these high slopes. All the eastern Spanish littoral, except the Pyrenean coast, has a rainfall of 16 inches or less (400 mm. or less),[128] and therefore was compelled to import its timber from the mountains or from overseas. The juniper beams in the temple of Diana at Saguntum were said to have been brought by the original Greek colonists from Zacynthus.[129]

Southern Sicily has a meager rainfall, but Aetna and the mountains along the northern coast get sufficient precipitation for moderate forests. Early Greek legend represented it as well wooded, abounding in stately oak groves and open forest glades where cattle pastured.[130] Odysseus found this island of the Cyclops covered with trees, among them "tall pines and crested oaks."[131] Evidence of local ship timber is found in the big fleets maintained for centuries by the tyrants of Syracuse and other Sicilian cities. These enterprising rulers doubtless drew their main supply from the ample forests of Aetna;[132] and they may also have tapped the resources of the Sila Mountains across the Strait of Messina, in those periods when Syracuse extended its control over Bruttium.

Italy was the chief seat of the lumber trade in the Western Mediterranean, owing to the considerable rainfall (30 to 40 inches or more) on the Alps and Apennines. The eastern littoral, lying in the rain shadow of the Apennines, was poorly provided with timber; but the western and northern plains, even near sea level, had a goodly covering of forests as late as the end of the fourth century B. C. Both the hills and plains of Latium were well supplied with timber. Pliny and Livy mention numerous ancient woodlands in the vicinity of Rome.[133] Theophrastus considers Italy one of the important sources of ship timber accessible from the Mediterranean.[134] He praises the fir and pine of Latium, but finds them excelled by the tall coniferous forests of Corsica. He mentions the fine beech groves of the Latin plain from which the Etruscans got very long planks for the keels of their

128 Philippson, *Das Mittelmeergebiet*, p. 119, map iii. Leipzig, 1907.

129 Pliny, *Hist. Nat.*, xvi, 40.

130 Diodorus Siculus, iv, 5.

131 Odyssey, ix,, 112-113, 186.

132 Strabo, Bk. vi, ch. ii, 8.

133 Livy, *Historia Romae*, i, 30, 33; ii, 7. Pliny, *Hist. Nat.*, xvi, 10, 15.

134 Theophrastus, *Hist. Plant.*, Bk. iv, ch. v, 5.

ships, and comments on the abundant growth of oak, laurel and myrtle on the promontory of Circei.[135]

Hence during Italy's early centuries of retarded economic development, when she furnished only raw materials to commerce, one of her chief items of export was ship timber.[136] It is probable that firs and other woods from the northern Apennines figured in the early commercial dealings of the Etruscans with the Carthaginians, for the domestic timber of the latter was comparatively limited in variety. Greece, as we have seen, probably drew upon Italian lumber, both from the mainland and from Corsica. The forests of Corsica reached down to the shore; they were therefore readily accessible and made the island an object of conquest. At some very early date timber was cut there by the Romans, and conveyed away on rafts provided with sails. One of these was broken up by a storm and lost.[137] It was probably these wooded shores of Corsica which gave the island a high repute far away on the Ionian coast of Asia Minor, and which induced the ancient colonists from Phocaea to settle there. The Etruscans expelled the strangers from this choice forest reserve, and for centuries after exacted a tribute of pitch, honey and wax from the island.[138] Later the Romans exploited its fine boxwood, for box trees grew there to extraordinary height.[139] The familiarity of Theophrastus with this particular Corsican product[140] suggests that it was imported into Greece, where the hard, close-grained wood was used in carving images of the gods.[141]

The early Etruscans sought timber far afield because of some peculiar fitness for their purposes, like the long beech logs of Latium,[142] or because of its superior accessibility. They had ample wood at home, owing to the northern location of their district and its numerous mountain ranges. The Ciminian forest covering the hill range of Mt. Ciminius in southern Etruria was, in 310 B. C., considered as frightful and impassable by the Roman army as were the vast German forests centuries later. Not even a trader with his pack mule dared to traverse it.[143] In the Second Punic War a fleet of thirty ships was contributed by the Etruscan cities to the navy of Rome. The timber was donated by Volaterrae, Clusium and Perusia, all located in the hills of Etruria, and Rusellae on the coast, which commanded the fir

135 Ibid. Bk. v, ch. viii, 1-3.
136 Mommsen, History of Rome, vol. ii, p. 255. New York, 1906.
137 Theophrastus, *Hist. Plant.*, Bk. v, ch. viii, 2.
138 Diodorus Siculus, v 13.
139 Ibid, v, 1. *Pliny, Hist. Nat.*, xvi, 16.
140 Theophrastus, *Hist. Plant.*, Bk. iii, ch. xv, 5.
141 Ibid. Bk. v, ch. iii, 1, 7.
142 Ibid. Bk. v, ch. viii, 3.
143 Livy, *Hist. Romae*, ix, 35-36.

forests of the Umbria River basin.[144] The Tiber river with the tributary Clanis, Tinia, Nar and Anio, tapped the Apennine forests of Etruria, Umbria, and the high Abruzzi Plateau of the Sabine country, and brought thence the immense supplies of lumber required by the growing capital of Rome.[145] From these sources came the longest and straightest planks used in Rome to build its villas, palaces and temples during the time of Augustus.[146]

Where the Apennines bend westward and trace the Ligurian coast, they get over 50 inches of rain a year. Their rain-drenched slopes were therefore covered with dense forests in ancient times. Trees grew there to immense height and sometimes measured eight feet in diameter. Much of the wood was very superior, beautifully veined, and equal to cedar for cabinet work. This, together with excellent ship timber, was exported through the port of Genoa.[147] The Roman naval base of Luna, located in a deep bay (Bay of Spezia) on the southern edge of the Ligurian Apennines, undoubtedly drew thence its abundant ship supplies. This choice timber of the northern Apennines had once been employed in constructing the vessels of the Etruscan pirates; later it built the triremes of ancient Pisa for her long wars against the Ligurian pirates,[148] and later still the growing fleets of Rome. In the Middle Ages it equipped the merchant marine and navy of both the Pisan and Genoese Republics, when competing for the trade of the Mediterranean and fighting Saracen pirates.

Northern Italy had abundant timber also on the Alpine slopes and in the Po valley, but these supplies were in general too remote from the big centers of population in the south for the export of crude lumber, unless in response to a special demand. Larch trees which were found only in this northern district and which furnished very long, straight timbers, were transported from the Alpine valleys by the Po River to Ravenna, and from there were distributed along the neighboring coasts as far south as Ancona; but they could not stand the costly haul to Rome.[149] However, Tiberius Caesar, needing long beams for the construction of a bridge over his *naumachia,* ordered larch trees to be cut on the Rhaetian Alps and brought to Rome. One of these large logs was 120 feet long.[150] The finest bird's eye or "peacock" maple to be found anywhere came from the Rhaetian Alps and the hill ranges of the Istrian peninsula. It ranked with the famous

144 Ibid. xviii, 45.
145 Strabo, Bk. v, ch. ii, 5; ch. iii, 7.
146 Strabo, Bk. v, ch. ii, 5.
147 Strabo, Bk. iv, ch. vi, 2.
148 Strabo, Bk. v, ch. ii, 5.
149 Vitruvius, *De Architectura,* Bk. ii, ch. ix, 14-17.
150 Pliny, *Hist. Nat.,* xvi, 39-40.

citrus wood in point of beauty, and was so valuable for cabinet work[151] that it could bear the heavy transportation charges to distant Rome.

Ship timber from the eastern Alps was undoubtedly floated down to the Adriatic in very early times to build the Etruscan merchant ships at Adria and Spina, and later to equip the transport and naval vessels of the Romans in the ports of Aquileia and Pola. On a larger scale, however, forest products of small bulk, such as resin, pitch, honey and wax, were contributed by the tribes of the eastern Alps to Mediterranean commerce in exchange for food stuffs, and were shipped from Aquileia and other Adriatic ports.[152] Fine resin used in medicine came from the foothills of the Italian Alps.[153] Cisalpine Gaul had extensive pitch works, and manufactured huge wooden wine casks lined with pitch, which aroused the admiration of Strabo.[154] This cooperage business was coupled with an active and long established pork-packing industry, for the abundant mast in the oak, beech and chestnut groves of the Po valley supported large herds of swine.[155]

The Mediterranean coast of Transalpine Gaul and its Rhone valley hinterland, owing to its northern location, had ample forests. These furnished timber for the rafts and dugout boats which forwarded native traffic on the river;[156] and also equipped the merchant marine of the Greek traders of Massilia from the sixth century B. C.[157] An ancient export trade in ham and bacon from the Rhone valley to Rome indicates mast groves in this district, while a similar trade from the eastern Pyrenees points to forests there.[158] The conifers of the Pyrenean hinterland of the Mediterranean, nourished by a rainfall of 30 inches (750 mm.) or more, undoubtedly maintained the merchant fleets of the ancient Greek colonies of Emporiae and Rhoda, western outposts of the Massiliot settlements, while the woods of the Maritime Alps equipped the ships of the eastern outposts, Antipolis, Nicaea, and Portus Monoei, as likewise of the native pirates, who raided Massilian commerce.

All this northern timber belt of the western Mediterranean lies within the limits of the middle-European forests. In ancient times it produced finer, more varied and abundant timber than was generally to be found in the southern districts. Moreover, the stretch from the Pyrenees to the Julian Alps long remained a colonial frontier of Rome, and hence served as a forest reserve after all the good timber of Latium

151 Ibid, xvi, 15.

152 Strabo, Bk. iv, ch. vi, 9-10; Bk. v, ch. i, 8.

153 Pliny, *Hist. Nat.*, xvi, 11.

154 Strabo, Bk. v, ch. i, 12.

155 Polybius, ii, 15. Varro, *Rerum Rusticarum*, ii, 4.

156 Polybius, iii, 42. Livy, *Hist. Romae*, xxi, 26.

157 Strabo, Bk. iv, ch. i, 5.

158 Strabo, Bk. iii, ch. iv, 11.

and other densely populated districts of the Peninsula had been exhausted.

The denudation of the Mediterranean forests progressed rapidly in antiquity, especially in the Eastern Basin, which in the beginning was more scantily provided with timber and developed big centers of population and advanced civilization earlier than the Western Basin. Therefore its supply was small and the demand was great. Plato, in the fifth century B. C., deplores the reckless destruction of the forests and the consequent failure of springs and streams in Greece, owing to the rapid run-off of the rain from the bared hillsides. He also indicates that the Greeks for a long time had been turning their attention to raising forest trees by cultivation,[159] probably in an effort to maintain a local supply of timber for minor local needs. A century later Theophrastus complained that the supply of ship timber in the Eastern Basin was very limited, and that only the forests of Macedonia and Thrace remained fairly abundant.[160] In the same period the cedar groves of Cyprus were retreating from the coasts into the mountain interior of the island, though the woods of the Lebanon range still survived, owing to the elevation and westward exposure of the mountains. One is led to surmise also that those expert Phoenician woodsmen, who were commended by King Solomon, may have understood the fundamental principles of forestry and therefore have intelligently exploited their timber supplies. The small copses and meager woodlands of ancient Palestine were unable to stand the onslaughts of civilization. Therefore for Abraham and other ancient sheiks it was an act of merit to plant even a solitary tree by a pool or spring.[161] The Jews cultivated walnut and fig trees for the wood as well as for the fruit.[162] They regarded the destruction of their groves by fire as a visitation from on high,[163] and the wanton destruction of fruit trees in war as a heinous offense.[164]

In the Western Mediterranean, the recession of the forests became very apparent, but at a later date. Though the lumber trade of Italy was active enough to supply the large demand, ancient Roman farmers, as indicated by Cato's treatise on Agriculture, early began to raise plantations of various trees on their estates by irrigation, and thus supply their immediate needs for timber by local production. Under the Empire arboriculture was practiced on all Roman farms, as indicated by the instructions of Vergil, Varro, Columella and Pliny. The

159 Plato, Critias, ch. v, p. 418. Trans. by Henry Davis. London, 1870.

160 Theophrastus, *Hist. Plant.*, Bk. iv, ch. v, 5.

161 Genesis, xxi, 33.

162 G. Adam Smith Historical Geography of the Holy Land, pp. 80-81. N. Y. 1897.

163 Isaiah, x, 18-19.

164 Deuteronomy, xx, 19.

steady demand for cedar for the roofs of temples and palaces and superior buildings caused a restriction of the supply, for the best trees grew only in Africa, Crete, Syria and Cilicia.[165] In Pliny's time the superb forests of this wood on Mt. Ancorarius in Hither Mauretania were already exhausted.[166] Even before this Roman lumber ships sought the far away Caucasus ports. Denudation of the forests made such inroads upon the wood supply of Italy that by the fifth century Roman architectural technique had become modified to meet the growing scarcity and increased price of wood.[167]

Clearing for tillage land and the legitimate consumption of wood as lumber and fuel were only part of the process of destruction. The long dry summers and the predominantly resinous character of Mediterranean timber made forest fires especially frequent and disastrous, while the high winds of the hot season fanned the flames. Such fires were a commonplace in ancient Palestine. Isaiah describes one in a metaphorical passage: "It shall devour the briers and thorns, and shall kindle in the thickets of the forest, and they shall mount up like the lifting up of smoke."[168] Homer knows the effect of protracted drought and strong summer winds upon such a conflagration. "Through deep glens rageth fierce fire on some parched mountain side and the deep forest beneath, and the wind, driving it, whirleth everywhere the flame."[169] The Greeks were familiar with the spontaneous origin of such fires in the mutual attrition of branches or trees in the dry season.[170]

Fires were often started, either intentionally or accidentally, by the herdsmen who ranged the mountain forests with their flocks of sheep and goats in the dry season. Burning improved the pasturage, because the ashes temporarily enriched the soil, and the abundant shoots from the old roots furnished better fodder. The forests once destroyed were hard to restore. Goats clipped the young growth from the hillsides as with shears. Trees which depended on deep root systems for their moisture could not survive the summer drought; saplings with shallow roots could not get a start. Moreover, there was no shade to help conserve the surface moisture in soil and root, at a season when the dry atmosphere was especially pervious to the sun's light and heat.

The chemical decomposition of rocks has always proceeded slowly in Mediterranean lands, owing to the lack of sufficient moisture for abundant plant life. Mechanical disintegration has also been slow,

165 Vitruvius, *De Architectura,* Bk. ii, ch. ix, 13.

166 Pliny, *Hist. Nat.,* xiii, 15.

167 Kingsley Porter, personal communication.

168 Isaiah, ix, 18; x, 17-19.

169 Iliad, xx, 490-492. Also xi, 154-157; xxi, 340-349.

170 Thucydides, ii, 77.

owing to the lack of intense cold. Hence both weathering processes have been weak, with the result that soil has accumulated by infinitesimal degrees, and has spread in a very thin mantle over the slopes. Except in the small silted valleys the rocks lie near the surface. Alluvial plains of considerable extent are rare; plains of loess or glacial clay are wanting.[171] The rock skeletons of Mediterranean lands are everywhere prone to thrust through the meager envelope of soil.

When the mountains were denuded of their forests, the violent autumn storms with their sudden downpour of rain scoured off the thin covering of earth from the steep declivities. The shield of foliage was no longer there to break the impact of the rain; the network of roots no longer held the light humus to the slopes. A stunted thorny scrub, the *maquis,* rooted in shallow pockets of earth, succeeded the denuded forests which formerly conserved and distributed moisture in the dry season, and preserved large areas for cultivation by irrigation.[172] Under the assault of the goats, the *maquis* even has grown shorter and thinner, exposing ever larger spaces to the scouring action of rain in winter and wind in summer, till mountains have become quite bare, as in parts of Greece and Spain. In many sections of the Mediterranean a single deforestation has meant denudation of the soil also and hence, the permanent destruction of the forests.[173]

Hence all Mediterranean lands today show a low percentage of forested area, despite the predominant mountain relief which would naturally be devoted to tree growth. Spain has 20.8 per cent of her area in forests, Portugal 5.2 per cent, Italy 15.7, Greece, 9.3.[174] These are much lower percentages than are to be found in Germany, Switzerland, Norway or Japan; yet even these probably represent in part a low scrub and not genuine forests.

171 Philippson, *Das Mittelmeergebeit,* pp. 142-144. Leipzig, 1907.

172 M. Newbegin, Modern Geography, pp. 119-128. London 1911.

173 Philippson, *Das Mittelmeergebeit,* p. 144. Leipzig, 1907.

174 Ibid, p. 154.